A METHOD OF FINDING THE PREDICTION DIRECTION IN
INTRAFRAME VIDEO CODING

The present invention relates to a method of finding
the prediction direction in intraframe video coding.

5   One particularly advantageous application of the
invention is to intraframe video coding as defined in the
H.264/MPEG-4 AVC standard.

Video coding an image generally consists in
effecting on that image operations known as compression,
10   with the aim of facilitating the transmission of the
image over telecommunications networks by reducing the
quantity of data to be transmitted, at the same time as
attempting to obtain a final reproduced image of the best
possible quality.

15   Interframe image coding essentially consists in
establishing the difference between a current image and
an image predicted from preceding images. Only the
difference is transmitted, which represents a high level
of compression since the quantity of data to be
20   transmitted is considerably reduced.

In intraframe coding the video image is coded with
respect to itself, with no reference and no comparison
with other images, in particular with preceding images.

In a video call, intraframe coding is necessary for
25   initialization and synchronization and has the particular
feature of limiting the dependency of an image block to
adjacent blocks only. This form of coding has the
advantage of being robust. However, it has the
disadvantage that image compression is not so good.

30   In recent coding standards, such as the ITU-T
standard H.264 (ISO/IEC/JTC1 standard MPEG-4 AVC),
intraframe block coding relies on prediction relative to
adjacent picture elements (pixels). The prediction of a
block leads to the construction of a virtual block for
35   the current block, comparing the virtual block with the
current block determines the difference between the
virtual block and the current block, and the difference

is transmitted over the network accompanied by additional data enabling the block to be reconstituted from this difference. Appropriate processing by the receiver reconstitutes the video image by applying the difference
5   transmitted to the virtual block reconstructed by means of this additional data. Intraframe coding therefore has the same advantage of better compression as interframe coding.

To improve intraframe coding, prediction directions
10   are defined that are used to interpolate the pixels of an adjacent block to predict the current block, i.e. to construct a virtual block associated with each prediction direction, and the virtual block that compares best with the current block determines the difference to be
15   transmitted over the network. In other words, each prediction direction is associated with a different processing algorithm yielding a different virtual block. There are therefore as many virtual blocks for the same current block as there are prediction directions. Of
20   course, the prediction direction chosen is that which minimizes the quantity of data to be transmitted at the same time as keeping the best possible quality, in other words, the direction that achieves the best quality/compression trade-off.
25   A conventional method of enabling the coder to decide on the best prediction direction systematically calculates all the virtual blocks for all possible prediction directions and then compares all these virtual blocks with the current block to determine the direction
30   that gives the smallest difference between the associated virtual block and the current block.

However, because of its complexity, entailing calculating all the necessary interpolations for calculating all the virtual blocks, this method proves
35   very costly in terms of computation time.

Accordingly, the technical problem to be solved by the subject matter of the present invention is that of

providing, in an intraframe video coding process that calculates virtual blocks associated with a current image block in given prediction directions, a method of finding the prediction direction of the current image block that

5   reduces the calculation time needed to find the best prediction direction, i.e. the prediction direction that yields the virtual block closest to the current block.

According to the present invention, the solution to the stated technical problem consists in said method

10   comprising the following steps:

· selecting two initial prediction directions from the given prediction directions,

· calculating virtual blocks associated with said initial prediction directions,

15   · comparing said virtual blocks with the current block and selecting the initial prediction direction that minimizes the difference between the associated virtual block and the current block, which prediction direction is then called the first main direction,

20   · calculating virtual blocks associated with the prediction directions immediately adjacent to said first main direction,

· comparing the virtual blocks associated with the first main direction and said immediately adjacent

25   directions with the current block to determine the best prediction direction, which is the prediction direction that minimizes the difference between the associated virtual block and the current block,

· if said best prediction direction is said first

30   main direction or one of the immediately adjacent directions if it is situated at one extremity of the set of prediction directions, deciding this best direction is the required prediction direction, otherwise,

· selecting the prediction direction that minimizes

35   the difference between the associated virtual block and the current block, which is then called the second main direction,

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· calculating the virtual block associated with the prediction direction other than the first main direction that is immediately adjacent to the second main direction,

5   · comparing the virtual blocks associated with the second main prediction direction and with said immediately adjacent direction with the current block to determine the best prediction direction, which is the prediction direction that minimizes the difference

10   between the associated virtual block and the current block,

· if said best prediction direction is said second main direction or the immediately adjacent direction if it is situated at one extremity of the set of prediction

15   directions, deciding that best direction is the required prediction direction, otherwise,

·   · continuing the process iteratively until the required prediction direction is found.

Accordingly, as emerges in more detail below, by

20   minimizing the number of directions tested by an iterative method, the invention finds the best prediction direction without it being necessary to calculate all the virtual blocks associated with all the prediction directions, which obviously leads to a reduction in the

25   corresponding calculation time.

In one particular implementation of the invention, said iteration is stopped if the best current prediction direction is adjacent to a direction immediately adjacent to the initial direction not retained as the first main

30   direction. This has the advantage of further limiting the number of prediction directions tested and thus of helping to reduce the calculation time required.

Finally, the invention also provides for said initial prediction directions to be vertical and

35   horizontal directions as defined in the H.264/MPEG-4 AVC standard. These directions are those whose

interpolations relative to the other diagonal directions are the simplest to calculate.

The following description with reference to the appended drawings, provided by way of non-limiting example, explains in what the invention consists and how it may be reduced to practice.

· Figure 1 is a diagram of the prediction directions adopted for intraframe coding in the H.264/MPEG-4 AVC standard.

· Figure 2 is the same diagram as Figure 1 indicating the initial prediction directions used by the method of the invention.

· Figure 3 is the same diagram as Figures 1 and 2 showing the terminology used to designate the prediction directions.

· Figure 4 is a flowchart of the method of the invention.

Figure 1 represents the eight prediction directions of the H.264/MPEG-4 AVC standard for calculating eight virtual blocks of a current block, including the virtual block having the least difference with respect to the current block that will determine the best prediction direction, i.e. the direction that will be used for intraframe coding of the image.

The best prediction direction comparison calculation may be effected in various ways, for example by calculating the sum of the absolute value differences between the pixels being coded and the corresponding prediction. The sums obtained can then be compared and only the smallest sum retained.

Figure 3 shows the correspondence between the Figure 1 prediction directions and the names of those directions used below.

The first step of the method of the invention firstly selects from the eight prediction directions two starting prediction directions, called the initial directions.

As indicated in Figure 2, it is advantageous to choose the horizontal and vertical prediction directions, i.e. the directions "0" and "1" in Figure 1 and the directions S and E in Figure 3. The interpolations for
5 these two particular directions relative to the other directions are very simple to calculate, requiring only one pixel to be looked up in the memory of the system, the value of which pixel is simply copied into the virtual block. For the other prediction directions, the
10 complexity is much greater and depends on the diagonal. The H.264/MPEG-4 AVC standard discusses the evaluation of this complexity as a function of the prediction direction.

As can be seen in the Figure 4 flowchart, the
15 virtual blocks calculated in the two initial directions S and E are compared to the current block to determine the better of those two directions in terms of the difference between the associated virtual block and the current block. It is assumed here that the initial prediction
20 direction E is the better direction and therefore the direction retained for the remainder of the process. It is then referred to as the "first main direction".

The two prediction directions immediately adjacent to the first main direction E are then considered, namely
25 the directions ENE and ESE, and the associated virtual blocks are calculated.

The virtual blocks associated with the prediction directions E, ENE and ESE are compared to the current block to determine which of the three directions gives
30 the smallest difference compared to the current block.

If the first main direction E is the best direction, then that direction is considered to be the prediction direction required for intraframe coding of the block. The required direction having been found, the process
35 terminates.

The same applies if the direction ENE is the best direction. This direction being situated at one

extremity of the set of eight possible prediction
directions, the iteration cannot continue.   The process
is stopped, and this direction ENE is taken as the
required prediction direction.

5   Otherwise the best prediction direction is the
direction ESE, which is called the "second main
direction".

The process continues by considering the prediction
direction immediately adjacent to the second main
10   direction ESE that is not the first main direction E.   In
the present example, this is the prediction direction SE.
The virtual block associated with the prediction
direction SE is calculated and compared to the current
block.

15   Two situations can arise: either the second main
direction ESE is the better direction and therefore
constitutes the best prediction direction, in which case
the process terminates, or else the direction SE is the
better direction.   From SE, iteration toward the
20   direction SSE can continue in the same way, by comparing
the directions SE and SSE.   However, the iteration could
equally well be stopped, as shown in Figure 4, by
considering the direction SE to be the best if it is
assumed that the direction SSE close to the initial
25   direction S that was not retained cannot be better than
the direction SE.   This saves even more calculation time
by avoiding an operation that has every chance of proving
to be of no utility.

The method described above is executed by a coding
30   device comprising means adapted to execute the steps
explained above.   The coding device is preferably an
electronic data processing device incorporating a
software module containing software instructions for
commanding execution of the steps of the method by the
35   coding device.   Consequently, the invention also relates
to a software module for a coding device comprising
software instructions for having the coding device

execute the above method and a coding device comprising that software module. The software module can be stored in or transmitted by a data medium. That medium may be a hardware storage medium, for example a CD-ROM, a magnetic

5   disc or a hard disc, or a transmissible medium, such as an electrical, optical, or radio signal.